## Tetra Tech, Inc.

	DATA VALIDATION REPORT LEVEL II
Site:	West Lake Landfill Site, Bridgeton, Missouri
Laboratory:	TestAmerica Laboratories, Inc. (Earth City, Missouri)
Data Reviewer:	Harry Ellis, Tetra Tech, Inc. (Tetra Tech)
Review Date	August 21, 2014
Sample Delivery Group (SDG):	J7447
Sample Numbers:	WAA-01-AF-PS-20140710, WAA-02-AF-PS-20140710, WAA-03-AF-PS-20140710, WAA-04-AF-PS-20140710, WAA-05-AF-PS-20140710 and WAA-00-AF-TB-20140710
Matrix / Number of Samples:	5 Air Samples and 1 Trip Blank
locuments entitled "Contract Labo	to the U.S. Environmental Protection Agency (EPA) Region 7 ratory Program National Functional Guidelines for Superfund Organic ). June 2008. In addition, the Tetra Tech document "Review of Data

PA) Region 7 T for Superfund Organic d ent "Review of Data Packages from Subcontracted Laboratories" (February 2002) and the EPA and others document "Multi-Agency Radiological Laboratory Analytical Protocols Manual" (July 2004) were used along with other criteria specified in the applicable methods.

The review was intended to identify problems and quality control (QC) deficiencies that were readily apparent from the summary data package. The following sections discuss any problems or deficiencies that were found, and data qualifications applied because of non-compliant QC. The data review was limited to the available field and laboratory QC information submitted with the project-specific data package.

I, Harry Ellis, certify that all data validation criteria outlined in the above-referenced documents were assessed, and any qualifications made to the data accorded with those documents.

Hang N. Ellis	I		21 August 2014
Certified by Harry Ellis, Chemist		Date	

1

SDG J7447

### DATA VALIDATION QUALIFIERS

The analyte was not detected above the reported sample quantitation limit.
 The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
 The analyte was not detected above the reported sample quantitation limit, which is estimated.
 The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet QC criteria. Presence or absence of the analyte cannot be verified.

#### DATA ASSESSMENT

Sample delivery group (SDG) J7447 included five (5) environmental air (filter) samples and one (1) QC sample (a field blank). Samples were analyzed for total alpha-emitting radium by EPA SW-846 Method 9315 and for isotopic (alpha-emitting) thorium and radium by Department of Energy (DOE) Method A-01-R. The following summarizes the data validation that was performed.

#### RADIOANALYTICAL ANALYSES

#### I. Holding Time and Chain of Custody (COC) Requirements

The samples were received by the laboratory and analyzed within the established holding time of 6 months from sample collection to analysis. No data were qualified.

#### II. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

Insufficient sample was available for MS/MSD analyses. Duplicate LCS analysis provided adequate data on precision and accuracy. No qualifications were applied.

#### III. Blanks

The laboratory (method) blank yielded low activities for two of three thorium isotopes and no uranium isotopes, while the field blank yielded low activities for the same two thorium isotopes and all three uranium isotopes. These blank activities were similar to those seen in the other field samples. No qualifications were applied.

#### IV. Laboratory Control Sample (LCS)

All percent recoveries and the relative percent differences from the duplicate LCS analyses were within established control limits. No qualifications were applied.

#### V. Surrogates

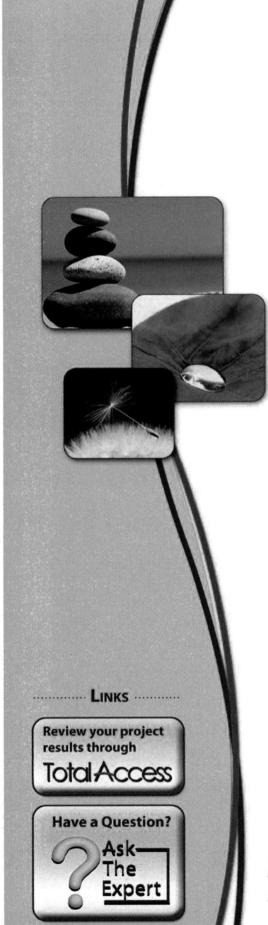
These radioanalytical methods use a "carrier" or "tracer", whose recovery serves the same functions as surrogate recoveries. All carrier and tracer recoveries were within the laboratory's QC limits.

#### VI. Comments

All detected results for thorium and uranium were less than their reporting limits ("RL"). These extrapolations should be qualified as estimated (flagged "J"). The total alpha radium results had minimum detectable concentrations (MDC) near the RL due to small sample size; one sample (WAA-03-AF-PS-20140710) had an MDC above the RL. The one detected result, from sample WAA-02-AF-PS-20140710, was barely above its MDC and is also qualified as estimated.

#### VII. Overall Assessment of Data

Overall data quality is acceptable, with few qualifications applied. All data are usable as qualified for their intended purposes.



Visit us at:

www.testamericainc.com

# <u>TestAmerica</u>

THE LEADER IN ENVIRONMENTAL TESTING

## ANALYTICAL REPORT

TestAmerica Laboratories, Inc. TestAmerica St. Louis 13715 Rider Trail North Earth City, MO 63045 Tel: (314)298-8566

TestAmerica Job ID: 160-7447-1

Client Project/Site: West Lake Landfill - Filters

For:

Tetra Tech EM Inc. 415 Oak Street Kansas City, Missouri 64106

Attn: Ms. Emily Fisher

Ul-

Authorized for release by: 8/11/2014 11:21:07 AM

Erika Gish, Project Manager II (314)298-8566 erika.gish@testamericainc.com

This report has been electronically signed and authorized by the signatory. Electronic signature is intended to be the legally binding equivalent of a traditionally handwritten signature.

Results relate only to the items tested and the sample(s) as received by the laboratory.

Client: Tetra Tech EM Inc. Project/Site: West Lake Landfill - Filters

## **Table of Contents**

Cover Page		 								 						1
Table of Contents																
Case Narrative				 												3
Chain of Custody		 														5
Receipt Checklists		 														6
Definitions/Glossary				 												7
Method Summary		 	 				 		 							8
Sample Summary		 										 				9
Client Sample Results .		 				 										10
QC Sample Results																
QC Association Summa	ry .	 			. ,	 										17
Tracer Carrier Summar																18

3

4

5

8

10

#### **Case Narrative**

Client: Tetra Tech EM Inc.

Project/Site: West Lake Landfill - Filters

TestAmerica Job ID: 160-7447-1

Job ID: 160-7447-1

Laboratory: TestAmerica St. Louis

Narrative

#### **CASE NARRATIVE**

Client: Tetra Tech EM Inc.

Project: West Lake Landfill - Filters

Report Number: 160-7447-1

With the exceptions noted as flags or footnotes, standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. In addition all laboratory quality control samples were within established control limits, with any exceptions noted below. Each sample was analyzed to achieve the lowest possible reporting limit within the constraints of the method. In some cases, due to interference or analytes present at high concentrations, samples were diluted. For diluted samples, the reporting limits are adjusted relative to the dilution required.

TestAmerica St. Louis attests to the validity of the laboratory data generated by TestAmerica facilities reported herein. All analyses performed by TestAmerica facilities were done using established laboratory SOPs that incorporate QA/QC procedures described in the application methods. TestAmerica's operations groups have reviewed the data for compliance with the laboratory QA/QC plan, and data have been found to be compliant with laboratory protocols unless otherwise noted below.

The test results in this report meet all NELAP requirements for parameters for which accreditation is required or available. Any exceptions to NELAP requirements are noted in this report. Pursuant to NELAP, this report may not be reproduced, except in full, without the written approval of the laboratory.

Calculations are performed before rounding to avoid round-off errors in calculated results.

All holding times were met and proper preservation noted for the methods performed on these samples, unless otherwise detailed in the individual sections below.

All solid sample results for Chemistry analyses are reported on an "as received" basis unless otherwise indicated by the presence of a % solids value in the method header. All soil/sediment sample results for radiochemistry analyses are based upon sample as dried and disaggregated with the exception of tritium, carbon-14, and iodine-129 by gamma spectroscopy unless requested as wet weight by the client."

This laboratory report is confidential and is intended for the sole use of TestAmerica and its client.

#### RECEIPT

The samples were received on 7/14/2014 1:10 PM; the samples arrived in good condition, properly preserved and, where required, on ice. The temperature of the cooler at receipt was 21.4° C.

#### TOTAL ALPHA RADIUM (GFPC)

Samples WAA-01-AF-PS-20140710 (160-7447-1), WAA-02-AF-PS-20140710 (160-7447-2), WAA-03-AF-PS-20140710 (160-7447-3), WAA-04-AF-PS-20140710 (160-7447-4), WAA-05-AF-PS-20140710 (160-7447-5) and WAA-00-AF-FB-20140710 (160-7447-6) were analyzed for Total Alpha Radium (GFPC) in accordance with SW- 846 Method 9315. The samples were prepared on 07/22/2014 and analyzed on 07/23/2014.

Insufficient sample volume was available to perform a matrix spike/matrix spike duplicate/sample duplicate (MS/MSD/DUP). The samples are filters that must be split between multiple analysis. A LCS/LCSD was used instead: WAA-00-AF-FB-20140710 (160-7447-6), WAA-01-AF-PS-20140710 (160-7447-1), WAA-02-AF-PS-20140710 (160-7447-2), WAA-03-AF-PS-20140710 (160-7447-3), WAA-04-AF-PS-20140710 (160-7447-4), WAA-05-AF-PS-20140710 (160-7447-5).

#### **Case Narrative**

Client: Tetra Tech EM Inc.

Project/Site: West Lake Landfill - Filters

TestAmerica Job ID: 160-7447-1

#### Job ID: 160-7447-1 (Continued)

#### Laboratory: TestAmerica St. Louis (Continued)

The total alpha emitting radium detection goal was not met for the following samples due to insufficient sample available for analysis; samples are filters and were split among other analyses: (LCS 160-133148/2-A), (LCSD 160-133148/3-A), WAA-03-AF-PS-20140710 (160-7447-3). Analytical results are reported with the detection limit achieved.

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

#### ISOTOPIC THORIUM (ALPHA SPECTROMETRY)

Samples WAA-01-AF-PS-20140710 (160-7447-1), WAA-02-AF-PS-20140710 (160-7447-2), WAA-03-AF-PS-20140710 (160-7447-3), WAA-04-AF-PS-20140710 (160-7447-4), WAA-05-AF-PS-20140710 (160-7447-5) and WAA-00-AF-FB-20140710 (160-7447-6) were analyzed for Isotopic Thorium (Alpha Spectrometry) in accordance with A-01-R. The samples were prepared on 07/22/2014 and analyzed on 07/28/2014.

Insufficient sample volume was available to perform a matrix spike/matrix spike duplicate/sample duplicate (MS/MSD/DUP). The samples are filters that must be split between multiple analysis. A LCS/LCSD was used instead: WAA-00-AF-FB-20140710 (160-7447-6), WAA-01-AF-PS-20140710 (160-7447-1), WAA-02-AF-PS-20140710 (160-7447-2), WAA-03-AF-PS-20140710 (160-7447-3), WAA-04-AF-PS-20140710 (160-7447-4), WAA-05-AF-PS-20140710 (160-7447-5).

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

#### ISOTOPIC URANIUM (ALPHA SPECTROMETRY)

Samples WAA-01-AF-PS-20140710 (160-7447-1), WAA-02-AF-PS-20140710 (160-7447-2), WAA-03-AF-PS-20140710 (160-7447-3), WAA-04-AF-PS-20140710 (160-7447-4), WAA-05-AF-PS-20140710 (160-7447-5) and WAA-00-AF-FB-20140710 (160-7447-6) were analyzed for Isotopic Uranium (Alpha Spectrometry) in accordance with A-01-R. The samples were prepared on 07/22/2014 and analyzed on 07/28/2014.

Insufficient sample volume was available to perform a matrix spike/matrix spike duplicate/sample duplicate (MS/MSD/DUP). The samples are filters that must be split between multiple analysis. A LCS/LCSD was used instead: WAA-00-AF-FB-20140710 (160-7447-6), WAA-01-AF-PS-20140710 (160-7447-1), WAA-02-AF-PS-20140710 (160-7447-2), WAA-03-AF-PS-20140710 (160-7447-3), WAA-04-AF-PS-20140710 (160-7447-4), WAA-05-AF-PS-20140710 (160-7447-5).

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

3

5

8

#### TestAmerica St. Louis

13715 Rider Trail North

Relinquished by:

## **Chain of Custody Record**

T_		LA			_		
	76.			7			CC
		7	71	1		11	ンし
-	-	-		-	_	-	_

Earth City, MO 63045 THE LEADER IN ENVIRONMENTAL TESTING phone 314,298,8566 fax Regulatory Program: DW NPDES RCRA Other: TestAmerica Laboratories, Inc. Client Contact Project Manager: Dave Kinroth Site Contact: Dave Kinroth Date:7-14-14 COC No: Tetra Tech, Inc. Tel/Fax: 314-517-6798 Lab Contact: Carrier: COCs 415 Oak Street **Analysis Turnaround Time** Sampler: Kansas City, MO 64106 WORKING DAYS CALENDAR DAYS For Lab Use Only: (816) 412-1786 Phone TAT if different from Below Walk-in Client: (816) 816-410-1748 FAX 9315 Total Alpha Radium 2 weeks Lab Sampling: Project Name: West Lake Landfill Site 1 week Site: Bridgeton, MO 2 days Job / SDG No.: PO# 1105610 П 1 day Samo Type Sample Sample Sample Identification Date Time G=Grab) Matrix Cont Sample Specific Notes: WAA-01-AF-PS-20140710 7/10/14 15:55 Filter Air 9315 Radium-226 (GFPC) 7/10/14 WAA-02-AF-PS-20140710 contingent upon TAR results 14:16 Filter Air 7/10/14 for all samples WAA-03-AF-PS-20140710 12:53 Air Filter WAA-04-AF-PS-20140710 7/10/14 13:51 Filter Air WAA-05-AF-PS-20140710 7/10/14 14:51 Filter Air WAA-00-AF-FB-20140710 7/10/14 NA Filter Air 160-7447 Chain of Custody Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other Possible Hazard Identification: Sample Disposal ( A fee may be assessed if samples are retained longer than 1 month) Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample. Non-Hazard ☐ Flammable Skin Irritant Poison B Unknown Return to Client Archive for Disposal by Lab Months Special Instructions/QC Requirements & Comments: Custody Seals Intact ☐ Yes Custody Seal No .: Cooler Temp. (°C): Obs'd: Corr'd: Therm ID No.: Relinquished by Company: Date/Time: Company: SID Uni 7-14-14 elinguished by Date/Time: Company: Company: Date/Time:

Date/Time:

Received in Laboratory by:

Company:

Company:

Form No. CA-C-WI-002, Rev. 4.3, dated 12/05/2013

Date/Time:

## Login Sample Receipt Checklist

Client: Tetra Tech EM Inc.

Job Number: 160-7447-1

List Source: TestAmerica St. Louis

Login Number: 7447 List Number: 1 Creator: Clarke, Jill C

Question	Answer Comment
Radioactivity wasn't checked or is = background as measured by a survey meter.</td <td>True</td>	True
The cooler's custody seal, if present, is intact.	N/A
Sample custody seals, if present, are intact.	True
The cooler or samples do not appear to have been compromised or tampered with.	True
Samples were received on ice.	N/A
Cooler Temperature is acceptable.	True
Cooler Temperature is recorded.	True
COC is present.	True
COC is filled out in ink and legible.	True
COC is filled out with all pertinent information.	True
Is the Field Sampler's name present on COC?	N/A
There are no discrepancies between the containers received and the COC.	True
Samples are received within Holding Time.	True
Sample containers have legible labels.	True
Containers are not broken or leaking.	True
Sample collection date/times are provided.	True
Appropriate sample containers are used.	True
Sample bottles are completely filled.	True
Sample Preservation Verified.	True
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	N/A
Multiphasic samples are not present.	True
Samples do not require splitting or compositing.	True
Residual Chlorine Checked.	N/A











## **Definitions/Glossary**

Client: Tetra Tech EM Inc.

Project/Site: West Lake Landfill - Filters

TestAmerica Job ID: 160-7447-1

Q	ua	lif	e	rs
---	----	-----	---	----

**RPD** 

TEF

TEQ

Qualifier	Qualifier Description
U	Result is less than the sample detection limit.
G	The Sample MDC is greater than the requested RL.

Relative Percent Difference, a measure of the relative difference between two points

Toxicity Equivalent Factor (Dioxin)

Toxicity Equivalent Quotient (Dioxin)

Glossary	
Abbreviation	These commonly used abbreviations may or may not be present in this report.
n	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CNF	Contains no Free Liquid
DER	Duplicate error ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision level concentration
MDA	Minimum detectable activity
EDL	Estimated Detection Limit
MDC	Minimum detectable concentration
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
NC	Not Calculated
ND	Not detected at the reporting limit (or MDL or EDL if shown)
PQL	Practical Quantitation Limit
QC	Quality Control
RER	Relative error ratio
RL	Reporting Limit or Requested Limit (Radiochemistry)

8/11/2014

## **Method Summary**

Client: Tetra Tech EM Inc.

Project/Site: West Lake Landfill - Filters

TestAmerica Job ID: 160-7447-1

Method	Method Description	Protocol	Laboratory
9315	Total Apha Radium (GFPC)	SW846	TAL SL
A-01-R	Isotopic Thorium (Alpha Spectrometry)	DOE	TAL SL
A-01-R	Isotopic Uranium (Alpha Spectrometry)	DOE	TAL SL

#### Protocol References:

DOE = U.S. Department of Energy

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

#### Laboratory References:

TAL SL = TestAmerica St. Louis, 13715 Rider Trail North, Earth City, MO 63045, TEL (314)298-8566

## **Sample Summary**

Client: Tetra Tech EM Inc.

Project/Site: West Lake Landfill - Filters

TestAmerica Job ID: 160-7447-1

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
160-7447-1	WAA-01-AF-PS-20140710	Filter	07/10/14 15:55	07/14/14 13:10
160-7447-2	WAA-02-AF-PS-20140710	Filter	07/10/14 14:16	07/14/14 13:10
160-7447-3	WAA-03-AF-PS-20140710	Filter	07/10/14 12:53	07/14/14 13:10
160-7447-4	WAA-04-AF-PS-20140710	Filter	07/10/14 13:51	07/14/14 13:10
160-7447-5	WAA-05-AF-PS-20140710	Filter	07/10/14 14:51	07/14/14 13:10
160-7447-6	WAA-00-AF-FB-20140710	Filter	07/10/14 00:00	07/14/14 13:10

5

6

8

Client Sample Results Client Tetra Tech EM Inc. TestAmerica Job ID: 160-7447-1 Project/Site: West Lake Landfill - Filters Client Sample ID: WAA-01-AF-PS-20140710 Lab Sample ID: 160-7447-1 Date Collected: 07/10/14 15:55 Matrix: Filter Date Received: 07/14/14 13:10 Method: 9315 - Total Apha Radium (GFPC) Count Total Uncert. Uncert. Result Qualifier  $(2\sigma + 1 -)$ MDC Unit Analyte  $(2\sigma + l - )$ Prepared Analyzed Dil Fac 0 816 pCi/Sample 07/23/14 15 44 Total Alpha Radium 0.274 U 0 468 0.469 1.00 07/22/14 15:40 Carrier % Yield Qualifier Limits Analyzed Dil Fac Prepared 101 40 - 110 07/22/14 15 40 07/23/14 15:44 Ba Carrier Method: A-01-R - Isotopic Thorium (Alpha Spectrometry) Count Total Uncert. Uncert. Analyte Result Qualifier  $(2\sigma + / -)$ (20+/-) RL MDC Unit Prepared Analyzed Dil Fac Thorium-228 0.277 0.119 0.122 1.00 0.147 pCi/Sample 07/22/14 11:27 07/28/14 15:25 3 Thorium-230 0.437 0.116 0.122 1.00 0.0231 pCi/Sample 07/22/14 11:27 07/28/14 15:25 Z Thorlum-232 0.0613 0.0485 0.0488 1.00 0.0587 pCi/Sample 07/22/14 11:27 07/28/14 15:25 Tracer % Yield Qualifier Limits Prepared Analyzed Dil Fac 95.1 30 - 110 07/22/14 11:27 07/28/14 15:25 Thorium-229 Method: A-01-R - Isotopic Uranium (Alpha Spectrometry) Count Total Uncert. Uncert. MDC Unit Prepared Analyzed Dil Fac Analyte Result Qualifier  $(2\sigma + / -)$ (20+/-) RL 07/22/14 11:27 07/28/14 15:29 0.0812 0.0823 1.00 0.0811 pCi/Sample Uranium-233/234 0.161 1.00 07/28/14 15:29 Uranium-235/236 0.0105 0.0211 0.0211 0.0316 pCi/Sample 07/22/14 11:27 0.0676 0.0478 0.0481 1.00 0 0254 pCi/Sample 07/22/14 11:27 07/28/14 15:29 Uranium-238 % Yield Qualifier Limits Prepared Analyzed Dil Fac Tracer Uranium-232 86.3 30 - 110 07/22/14 11:27 07/28/14 15:29 Client Sample ID: WAA-02-AF-PS-20140710 Lab Sample ID: 160-7447-2 Date Collected: 07/10/14 14:16 Matrix: Filter Date Received: 07/14/14 13:10 Method: 9315 - Total Apha Radium (GFPC) Count Total Uncert. Uncert. Oil Fac Qualifier  $(2\sigma + /-)$ (20+/-) RL MDC Unit Analyzed Analyte Result Prepared 07/23/14 15:45 0.864 pCi/Sample 07/22/14 15:40 Total Alpha Radium 1.11 0.638 0 645 1 00 Limits Prepared Analyzed Dil Fac

21 August 2914

40 - 110

Count

Uncert.

(20+/-)

0.121

0.115

0.0266

Carrier

Ba Carrier

Analyte

Thorium-228

Thorium-230

Thorium-232

%Yield

Method: A-01-R - Isotopic Thorium (Alpha Spectrometry)

Result

0.239

0.413

0.0231

100

Qualifier

Qualifier

Ī

3

TestAmerica St Louis

Dil Fac

07/23/14 15 45

Analyzed

07/28/14 15:25

07/28/14 15:25

07/28/14 15 25

07/22/14 15 40

Prepared

07/22/14 11:27

07/22/14 11 27

07/22/14 11 27

Total

Uncert.

(20+/-)

0 122

0.120

0.0267

RL

1.00

1.00

1.00

MDC Unit

0.162

0.0597

pCi/Sample

pCi/Sample

0.0231 pCi/Sample

## **Client Sample Results**

Client: Tetra Tech EM Inc. Project/Site: West Lake Landfill - Filters

TestAmerica Job ID: 160-7447-1

Client Sample ID: WAA-02-AF-PS-20140710

Date Collected: 07/10/14 14:16 Date Received: 07/14/14 13:10

Lab Sample ID: 160-7447-2

Matrix: Filter

	% Yield	Qualifier	Limits					Prepared	Analyzed	Dil Fa
Thorium 229	95.4	NA-MARKA MENANCEPERAN	30 - 110					07/22/14 11 27	07/28/14 15 25	
Method: A-01-R - Iso	topic Uraniu	ım (Alpha S	pectrometry)							
			Count	Total						
			Uncert.	Uncert.						
Analyte	Result	Qualifier	(20+/-)	(20+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fa
Uranium-233/234	0 0686	u	0.0594	0.0597	1.00	0.0822	pCi/Sample	07/22/14 11:27	07/28/14 15 29	
Uranium-235/236	0 0320	UU	0.0477	0.0478	1.00	0 0817	pCi/Sample	07/22/14 11:27	07/28/14 15:29	
Uranium-238	0.0856	3	0.0593	0 0598	1.00	0.0655	pCi/Sample	07/22/14 11:27	07/28/14 15:29	
Tracer	% Yield	Qualifier	Limits					Prepared	Analyzed	Dil Fa
Uranium-232	83.6		30 - 110					07/22/14 11:27	07/28/14 15:29	
lient Sample ID: \	WAA-03-A	F-PS-201	40710					Lah San	nple ID: 160-	7//7
ate Collected: 07/10/			10, 10					Lab Gail	-	x: Filte
ate Received: 07/14/									Wati	A. File
Mathada 0245 Tatal	Anha Dadio	(OFDO)	The second second							
Method: 9315 - Total	Aprila Radiu	iii (GFFC)	Count	Total						
			Uncert.	Uncert.						
Analyte	Result	Qualifier	(20+/-)	(20+/-)	RL	MDC	Unit	Prepared	Anglumed	Dil Fa
Total Alpha Radium	0.330	W.	0.664	0.664	1.00		pCi/Sample	07/22/14 15.40	Analyzed 07/23/14 15:45	DII Fa
Carrier	% Yield	Qualifier	Limits			$\sim$		Prepared	Analyzad	Dil Fa
Ba Carrier								* *************************************	Analyzed	UII Fa
	99.7		40 - 110					07/22/14 15:40	07/23/14 15 45	
ba Carrier	99.7		40 - 110					07/22/14 15:40	07/23/14 15.45	
		m (Alpha S	pectrometry)					07/22/14 15 40	07/23/14 15.45	
		m (Alpha S	pectrometry) Count	Total				07/22/14 15:40	07/23/14 15.45	
Method: A-01-R - Iso	topic Thoriu		pectrometry) Count Uncert.	Total Uncert.				07/22/14 15:40	07/23/14 15.45	
Method: A-01-R - Iso	topic Thoriu	m (Alpha S	pectrometry) Count Uncert. (2σ+/-)	Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	07/23/14 15.45 Analyzed	
Method: A-01-R - Iso	topic Thoriu	Qualifier	pectrometry) Count Uncert. (2σ+/-) 0.104	Uncert. (2σ+/-) 0 106	RL 1.00	MDC 0 137	Unit pCi/Sample			Dit Fa
Method: A-01-R - Iso Analyte Thorium-228	topic Thoriu	Qualifier 3	pectrometry) Count Uncert. (2σ+/-)	Uncert. (2σ+/-)			-	Prepared	Analyzed	Dil Fa
Method: A-01-R - Iso Analyte Thorium-228 Thorium-230	Result 0.202	Qualifier	pectrometry) Count Uncert. (2σ+/-) 0.104	Uncert. (2σ+/-) 0 106	1.00	0 137	pCi/Sample pCi/Sample	Prepared 07/22/14 11:27	Analyzed 07/28/14 15:25	Dit Fa
Method: A-01-R - Iso Analyte Thorium-228 Thorium-230 Thorium-232	Result 0.202	Qualifier 3	pectrometry) Count Uncert. (2σ+/-) 0.104 0.115	Uncert. (2σ+/-) 0.106 0.120	1.00	0 137 0 0570	pCi/Sample pCi/Sample	Prepared 07/22/14 11:27 07/22/14 11 27	Analyzed 07/28/14 15:25 07/28/14 15:25	Dit Fa
Method: A-01-R - Iso Analyte Thorium-228 Thorium-230 Thorium-232 <i>Tracer</i>	Result 0.202 0.426 0.0593	Qualifier  J	pectrometry) Count Uncert. (2σ+/-) 0.104 0.115 0.0419	Uncert. (2σ+/-) 0.106 0.120	1.00	0 137 0 0570	pCi/Sample pCi/Sample	Prepared 07/22/14 11:27 07/22/14 11:27 07/22/14 11:27	Analyzed 07/28/14 15:25 07/28/14 15:25 07/28/14 15:25	Dil Fa
Method: A-01-R - Iso  Analyte Thorium-228 Thorium-230 Thorium-232  Tracer Thorium-229	Result	Qualifier  Z  Z  Z  Qualifier	pectrometry) Count Uncert. (20+1-) 0.104 0.115 0.0419  Limits 30 - 110	Uncert. (2σ+/-) 0.106 0.120	1.00	0 137 0 0570	pCi/Sample pCi/Sample	Prepared 07/22/14 11:27 07/22/14 11:27 07/22/14 11:27 Prepared	Analyzed 07/28/14 15:25 07/28/14 15:25 07/28/14 15:25 Analyzed	Dil Fa
Method: A-01-R - Iso  Analyte Thorium-228 Thorium-230 Thorium-232  Tracer Thorium-229  Method: A-01-R - Iso	Result	Qualifier  Z  Z  Z  Qualifier	pectrometry) Count Uncert. (20+1-) 0.104 0.115 0.0419  Limits 30 - 110	Uncert. (2σ+/-) 0.106 0.120	1.00	0 137 0 0570	pCi/Sample pCi/Sample	Prepared 07/22/14 11:27 07/22/14 11:27 07/22/14 11:27 Prepared	Analyzed 07/28/14 15:25 07/28/14 15:25 07/28/14 15:25 Analyzed	Dil Fa
Method: A-01-R - Iso  Analyte Thorium-228 Thorium-230 Thorium-232  Tracer Thorium-229	Result	Qualifier  Z  Z  Z  Qualifier	pectrometry) Count Uncert. (20+1-) 0.104 0.115 0.0419  Limits 30-110  pectrometry) Count	Uncert. (2σ+/-) 0 106 0 120 0 0422	1.00	0 137 0 0570	pCi/Sample pCi/Sample	Prepared 07/22/14 11:27 07/22/14 11:27 07/22/14 11:27 Prepared	Analyzed 07/28/14 15:25 07/28/14 15:25 07/28/14 15:25 Analyzed	Dil Fac
Method: A-01-R - Iso  Analyte Thorium-228 Thorium-230 Thorium-232  Tracer Thorium-229  Method: A-01-R - Iso	Result 0.202 0.426 0.0593 %Yield 100	Qualifier  Z  Z  Z  Qualifier	pectrometry) Count Uncert. (20+1-) 0.104 0.115 0.0419  Limits 30-110  pectrometry)	Uncert. (2σ+/-) 0 106 0 120 0 0422	1.00	0 137 0 0570	pCi/Sample pCi/Sample pCi/Sample	Prepared 07/22/14 11:27 07/22/14 11:27 07/22/14 11:27 Prepared	Analyzed 07/28/14 15:25 07/28/14 15:25 07/28/14 15:25 Analyzed 07/28/14 15:25	Dil Fa
Method: A-01-R - Iso  Analyte Thorium-228 Thorium-230 Thorium-232  Tracer Thorium-229	Result 0.202 0.426 0.0593 %Yield 100	Qualifier    Compared to the c	pectrometry) Count Uncert. (2\sigma+l-) 0.104 0.115 0.0419  Limits 30-110  pectrometry) Count Uncert.	Uncert. (2σ+/-) 0 106 0.120 0.0422  Total Uncert.	1.00 1.00 1.00	0 137 0 0570 0.0222	pCi/Sample pCi/Sample pCi/Sample	Prepared 07/22/14 11:27 07/22/14 11:27 07/22/14 11:27 Prepared 07/22/14 11:27	Analyzed 07/28/14 15:25 07/28/14 15:25 07/28/14 15:25  Analyzed 07/28/14 15:25	Dil Fa
Method: A-01-R - Iso  Analyte Thorium-228 Thorium-230 Thorium-232  Tracer Thorium-229  Method: A-01-R - Iso  Analyte	Result 0.202 0.426 0.0593 %Yield 100 stopic Uraniu	Qualifier  Qualifier  am (Alpha S	Dectrometry) Count Uncert. (20+1-) 0.104 0.115 0.0419  Limits 30-110  Dectrometry) Count Uncert. (20+1-)	Uncert. (2σ+/-) 0 106 0.120 0.0422 Total Uncert. (2σ+/-)	1.00 1.00 1.00	0 137 0 0570 0.0222	pCi/Sample pCi/Sample pCi/Sample	Prepared 07/22/14 11:27 07/22/14 11:27 07/22/14 11:27 Prepared 07/22/14 11:27  Prepared 07/22/14 11:27	Analyzed 07/28/14 15:25 07/28/14 15:25 07/28/14 15:25  Analyzed 07/28/14 15:25  Analyzed 07/28/14 15:25	Dil Fa
Method: A-01-R - Iso Analyte Thorium-228 Thorium-230 Thorium-232 Tracer Thorium-229 Method: A-01-R - Iso Analyte Uranium-233/234	Result 0.202 0.426 0.0593 %Yield 100 ctopic Uraniu Result 0.0584	Qualifier  Qualifier  (Alpha S	Dectrometry) Count Uncert. (20+1-) 0.104 0.115 0.0419  Limits 30-110  Dectrometry) Count Uncert. (20+1-) 0.0553	Uncert. (2σ+/-) 0 106 0.120 0.0422  Total Uncert. (2σ+/-) 0.0555	1.00 1.00 1.00	0 137 0 0570 0.0222 MDC 0 0799	pCi/Sample pCi/Sample pCi/Sample	Prepared 07/22/14 11:27 07/22/14 11:27 07/22/14 11:27  Prepared 07/22/14 11:27	Analyzed 07/28/14 15:25 07/28/14 15:25 07/28/14 15:25 Analyzed 07/28/14 15:25	Dil Fa
Method: A-01-R - Iso  Analyte Thorium-228 Thorium-230 Thorium-232  Tracer Thorium-229  Method: A-01-R - Iso  Analyte Uranium-233/234  Uranium-235/236	Result 0.202 0.426 0.0593 %Yield 100 topic Uraniu  Result 0.0584 0 0207 0 0499	Qualifier  Qualifier  (Alpha S	pectrometry) Count Uncert. (2\sigma+l-) 0.104 0.115 0.0419  Limits 30-110  pectrometry) Count Uncert. (2\sigma+l-) 0.0553 0.0293	Uncert. (2σ+/-) 0 106 0.120 0.0422  Total Uncert. (2σ+/-) 0.0555 0.0294	1.00 1.00 1.00	0 137 0 0570 0.0222 MDC 0 0799 0 0311	pCi/Sample pCi/Sample pCi/Sample	Prepared 07/22/14 11:27 07/22/14 11:27 07/22/14 11:27 Prepared 07/22/14 11:27  Prepared 07/22/14 11:27	Analyzed 07/28/14 15:25 07/28/14 15:25 07/28/14 15:25  Analyzed 07/28/14 15:25  Analyzed 07/28/14 15:29	Dil Fa

HUE 21 Aug 14

## **Client Sample Results**

Client: Tetra Tech EM Inc.

Project/Site: West Lake Landfill - Filters

TestAmerica Job ID 160-7447-1

Client Sample ID: WAA-04-AF-PS-20140710

Date Collected: 07/10/14 13:51 Date Received: 07/14/14 13:10

Lab Sample ID: 160-7447-4

Matrix: Filter

			Count	Total						
			Uncert.	Uncert.						
nalyte	Result	Qualifier	(20+/-)	(20+/-)	RL	MDC	Unit	Prepared	Analyzed	Dii F
otal Alpha Radium	0.766	<b>W</b>	0.632	0.636	(1.00)	0.971	pCi/Sample	07/22/14 15 40	07/23/14 15 46	Dill
	******									
arrier		Qualifier	Limits					Prepared	Analyzed	Dill
a Carrier	102		40 - 110					07/22/14 15:40	07/23/14 15.46	
lethod: A-01-R - Isot	opic Thoriu	m (Alpha s		Total						
			Count Uncert.	Uncert.						
nalyte	Decult	Qualifier	(2σ+/-)	(2σ+/-)	RL	MDC	Unit	Danmanad	Amahanad	501
horium-228	0.210	-	0.123	0.124	1.00	0.174	pCi/Sample	Prepared 07/22/14 11:27	Analyzed 07/28/14 15 25	Dill
horium-230	0.433	7	0.125	0.130	1.00	0.0892	pCi/Sample	07/22/14 11:27	07/28/14 15:25	
horium-232	0.0287	Wi.	0.0609	0.0610	(1.00	0.111		07/22/14 11:27	07/28/14 15:25	
	0.0207		0.0003	0.0010		0.111	porsample	0112214 11.21	07/20/14 15:25	
racer	%Yield	Qualifier	Limits					Prepared	Analyzed	DII F
horium-229	90.7		30 - 110					07/22/14 11:27	07/28/14 15:25	
lethod: A-01-R - Isot	opic Uraniu	ım (Alpha 🤄	Spectrometry)							
			Count	Total						
			Uncert.	Uncert.						
nalyte	Result	Qualifier	(20+/-)	(20+/-)	RL	MDC	Unit	Prepared	Analyzed	DII
ranium-233/234	0.0829	7	0.0620	0.0624	1.00	0.0794	pCi/Sample	07/22/14 11:27	07/28/14 15:29	
Iranium-235/236	0.0206	u	0 0292	0.0292	1.00	0.0309	pCi/Sample	07/22/14 11:27	07/28/14 15:29	
		-	0.0438	0.0440	1.00	0.0248	pCi/Sample	07/22/14 11:27	07/28/14 15:29	
Iranium-238	0.0579	ラ	0.0436	0,0440	1.00	0.02.10				
ranium-238	0.0579 %Yield		Limits	0.0440	1.00	0.00.10	po	Prepared	Analyzed	Dil F
racer Iranium-232	%Yleld 84.0	Qualifier	Limits 30 - 110	0.0440				Prepared 07/22/14 11:27	Analyzed 07/28/14 15:29 nple ID: 160-	
racer Iranium-232 ient Sample ID: V ite Collected: 07/10/1	%Yleid 84.0 VAA-05-A 14.14:51	Qualifier	Limits 30 - 110	0.0770				Prepared 07/22/14 11:27	07/28/14 15:29 nple ID: 160-	7447
	%Yield 84.0 VAA-05-A 14 14:51 4 13:10	Qualifier F-PS-201	Limits 30 - 110					Prepared 07/22/14 11:27	07/28/14 15:29 nple ID: 160-	
iracer Iranium-232 ient Sample ID: V ite Collected: 07/10/1 ite Received: 07/14/1	%Yield 84.0 VAA-05-A 14 14:51 4 13:10	Qualifier F-PS-201	Limits 30 - 110	Total				Prepared 07/22/14 11:27	07/28/14 15:29 nple ID: 160-	7447
iracer Iranium-232 ient Sample ID: V ite Collected: 07/10/1 ite Received: 07/14/1	%Yield 84.0 VAA-05-A 14 14:51 4 13:10	Qualifier F-PS-201	Limits 30-110					Prepared 07/22/14 11:27	07/28/14 15:29 nple ID: 160-	7447
racer  Iranium-232  ient Sample ID: V te Collected: 07/10/1 te Received: 07/14/1  Method: 9315 - Total A	%Yield 84.0 VAA-05-A 14 14:51 4 13:10 Apha Radiu Result	Gualifier F-PS-201 Im (GFPC) Qualifier	Limits 30 - 110  40710  Count Uncert. (20+1-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared 07/22/14 11:27 Lab San	07/28/14 15:29  nple ID: 160-  Matri	7447 ix: Filt
racer  Iranium-232  ient Sample ID: V te Collected: 07/10/1 te Received: 07/14/1  Method: 9315 - Total A	%Yield 84.0 VAA-05-A 14 14:51 4 13:10 Apha Radiu Result	Gualifier F-PS-201 Im (GFPC) Qualifier	Limits 30 - 110 40710  Count Uncert.	Total Uncert.				Prepared 07/22/14 11:27 Lab San	07/28/14 15:29 nple ID: 160- Matri	7447 ix: Filt
iracer Iranium-232 ient Sample ID: V ite Collected: 07/10/1 ite Received: 07/14/1 Method: 9315 - Total A inalyte otal Alpha Radium	%Yield 84.0 VAA-05-A 14 14:51 4 13:10 Apha Radiu Result 0 163 %Yield	Gualifier F-PS-201 Im (GFPC) Qualifier	Limits  30 - 110  40710  Count Uncert. (20+1-) 0.487  Limits	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared 07/22/14 11:27  Lab San  Prepared 07/22/14 15:40  Prepared	07/28/14 15:29  nple ID: 160-  Matri  Analyzed  07/23/14 15:46  Analyzed	7447
iracer Iranium-232 ient Sample ID: V ite Collected: 07/10/1 ite Received: 07/14/1 Method: 9315 - Total A inalyte otal Alpha Radium	%Yield 84.0 VAA-05-A 14 14:51 4 13:10 Apha Radiu Result 0 163	Gualifier F-PS-201 Im (GFPC) Qualifier	Limits 30 - 110  40710  Count Uncert. (20+1-) 0.487	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared 07/22/14 11:27  Lab San  Prepared 07/22/14 15:40	07/28/14 15:29  nple ID: 160-  Matri  Analyzed  07/23/14 15:46	7447 ix: Fili
iracer Iranium-232 ient Sample ID: V ite Collected: 07/10/1 ite Received: 07/14/1 Method: 9315 - Total A	%Yield 84.0 VAA-05-A 14 14:51 4 13:10 Apha Radiu Result 0 163 %Yield	Gualifier F-PS-201 Im (GFPC) Qualifier Qualifier	Limits 30 - 110  40710  Count Uncert. (20+1-) 0.487  Limits 40 - 110  Spectrometry)	Total Uncert. (2σ+/-) 0 488	RL	MDC	Unit	Prepared 07/22/14 11:27  Lab San  Prepared 07/22/14 15:40  Prepared	07/28/14 15:29  nple ID: 160-  Matri  Analyzed  07/23/14 15:46  Analyzed	7447 ix: Fili
iracer Iranium-232 ient Sample ID: V te Collected: 07/10/1 te Received: 07/14/1 Method: 9315 - Total A analyte otal Alpha Radium carrier ta Carrier	%Yield 84.0 VAA-05-A 14 14:51 4 13:10 Apha Radiu Result 0 163 %Yield	Gualifier F-PS-201 Im (GFPC) Qualifier Qualifier	Limits 30 - 110  Count Uncert. (20+1-) 0.487  Limits 40 - 110  Spectrometry) Count	Total Uncert. (2σ+/-) 0 488	RL	MDC	Unit	Prepared 07/22/14 11:27  Lab San  Prepared 07/22/14 15:40  Prepared	07/28/14 15:29  nple ID: 160-  Matri  Analyzed  07/23/14 15:46  Analyzed	7447 ix: Fili
ient Sample ID: V ite Collected: 07/10/1 ite Received: 07/14/1 Method: 9315 - Total A inalyte otal Alpha Radium carrier la Carrier Method: A-01-R - Isot	%Yield 84.0 VAA-05-A 14 14:51 4 13:10 Apha Radiu Result 0 163 %Yield 100	Gualifier  F-PS-201  Im (GFPC)  Qualifier  Qualifier  Im (Alpha S	Limits  30 - 110  140710  Count Uncert. (20+1-) 0.487  Limits 40 - 110  Spectrometry) Count Uncert.	Total Uncert. (2σ+/-) 0 488 Total Uncert.	RL (1.00)	MDC 0.891	Unit pCi/Sample	Prepared 07/22/14 11:27  Lab San  Prepared 07/22/14 15:40  Prepared 07/22/14 15:40	07/28/14 15:29  nple ID: 160- Matri  Analyzed 07/23/14 15:46  Analyzed 07/23/14 15:46	7447 ix: Fill
ient Sample ID: Vite Collected: 07/10/1 te Received: 07/14/1 Method: 9315 - Total Airalyte otal Alpha Radium Carrier Method: A-01-R - Isot	%Yield 84.0 VAA-05-A 14 14:51 4 13:10 Apha Radiu Result 0 163 %Yield 100 opic Thoriu	Gualifier F-PS-201 Im (GFPC) Qualifier Qualifier	Limits  30 - 110  Count Uncert. (20+l-) 0.487  Limits 40 - 110  Spectrometry) Count Uncert. (20+l-)	Total Uncert. (20+/-) 0 488  Total Uncert. (20+/-)	RL 1.00	MDC 0.891	Unit pCi/Sample	Prepared 07/22/14 11:27  Lab San  Prepared 07/22/14 15:40  Prepared 07/22/14 15:40	07/28/14 15:29  nple ID: 160- Matri  Analyzed 07/23/14 15:46  Analyzed 07/23/14 15:46	7447 ix: Fill
ient Sample ID: V te Collected: 07/10/1 te Received: 07/14/1 fethod: 9315 - Total A nalyte otal Alpha Radium tarrier a Carrier flethod: A-01-R - Isot	%Yield 84.0 VAA-05-A 14 14:51 4 13:10 Apha Radiu Result 0 163 %Yield 100 opic Thoriu Result 0.225	Qualifier F-PS-201 Im (GFPC) Qualifier U Qualifier Im (Alpha S	Limits  30 - 110  Count Uncert. (20+l-) 0.487  Limits 40 - 110  Spectrometry) Count Uncert. (20+l-) 0.119	Total Uncert. (2σ+/-) 0 488  Total Uncert. (2σ+/-) 0 121	RL 1.00	MDC 0.891	Unit pCi/Sample Unit pCi/Sample	Prepared 07/22/14 11:27  Lab San  Prepared 07/22/14 15:40  Prepared 07/22/14 15:40  Prepared 07/22/14 15:40	07/28/14 15:29  nple ID: 160-  Matri  Analyzed  07/23/14 15:46  Analyzed  07/23/14 15:46	7447 ix: Fill
ient Sample ID: V te Collected: 07/10/1 te Received: 07/14/1 flethod: 9315 - Total A nalyte otal Alpha Radium carrier a Carrier flethod: A-01-R - Isot nalyte horium-228 horium-230	%Yield 84.0 VAA-05-A 14 14:51 4 13:10 Apha Radiu Result 0 163 %Yield 100 copic Thoriu Result 0.225 0.266	Qualifier  F-PS-201  Im (GFPC)  Qualifier  U  Qualifier  Gualifier	Limits  30 - 110  Count Uncert. (20+l-) 0.487  Limits 40 - 110  Spectrometry) Count Uncert. (20+l-) 0.119 0.0909	Total Uncert. (2σ+/-) 0 488  Total Uncert. (2σ+/-) 0 121 0 0938	RL 1.00 1.00	MDC 0.891 MDC 0.163 0.0233	Unit  pCi/Sample  Unit  pCi/Sample pCi/Sample	Prepared 07/22/14 11:27  Lab San  Prepared 07/22/14 15:40  Prepared 07/22/14 15:40  Prepared 07/22/14 11:27	O7/28/14 15:29  nple ID: 160- Matri  Analyzed  07/23/14 15:46  Analyzed  07/23/14 15:46  Analyzed  07/28/14 15:25  07/28/14 15:25	7447 Dit 1
racer ranium-232 ient Sample ID: V te Collected: 07/10/1 te Received: 07/14/1 lethod: 9315 - Total A nalyte otal Alpha Radium arrier a Carrier lethod: A-01-R - Isot nalyte horium-228 horium-230	%Yield 84.0 VAA-05-A 14 14:51 4 13:10 Apha Radiu Result 0 163 %Yield 100 opic Thoriu Result 0.225	Qualifier  F-PS-201  Im (GFPC)  Qualifier  U  Qualifier  Gualifier	Limits  30 - 110  Count Uncert. (20+l-) 0.487  Limits 40 - 110  Spectrometry) Count Uncert. (20+l-) 0.119	Total Uncert. (2σ+/-) 0 488  Total Uncert. (2σ+/-) 0 121	RL 1.00	MDC 0.891	Unit  pCi/Sample  Unit  pCi/Sample pCi/Sample	Prepared 07/22/14 11:27  Lab San  Prepared 07/22/14 15:40  Prepared 07/22/14 15:40  Prepared 07/22/14 15:40	07/28/14 15:29  nple ID: 160-  Matri  Analyzed  07/23/14 15:46  Analyzed  07/23/14 15:46	7447
ient Sample ID: V te Collected: 07/10/1 te Received: 07/14/1 lethod: 9315 - Total / nalyte otal Alpha Radium arrier a Carrier lethod: A-01-R - isot nalyte horium-228 horium-230 horium-232	%Yield 84.0 VAA-05-A 14 14:51 4 13:10 Apha Radiu Result 0 163 %Yield 100 Opic Thoriu Result 0.225 0.266 0 00863 %Yield	Qualifier  F-PS-201  Im (GFPC)  Qualifier  U  Qualifier  Gualifier	Limits  30 - 110  Count Uncert. (20+1-) 0.487  Limits  40 - 110  Spectrometry) Count Uncert. (20+1-) 0.119 0.0909 0.0490  Limits	Total Uncert. (2σ+/-) 0 488  Total Uncert. (2σ+/-) 0 121 0 0938	RL 1.00 1.00	MDC 0.891 MDC 0.163 0.0233	Unit  pCi/Sample  Unit  pCi/Sample pCi/Sample	Prepared 07/22/14 11:27  Lab San  Prepared 07/22/14 15:40  Prepared 07/22/14 15:40  Prepared 07/22/14 11:27 07/22/14 11:27 07/22/14 11:27 Prepared	O7/28/14 15:29  nple ID: 160- Matri  Analyzed  07/23/14 15:46  Analyzed  07/23/14 15:46  Analyzed  07/28/14 15:25  07/28/14 15:25	DH F
ient Sample ID: V te Collected: 07/10/1 te Received: 07/14/1 lethod: 9315 - Total A nalyte otal Alpha Radium sarrier a Carrier lethod: A-01-R - Isot nalyte horium-228 horium-230 horium-232	%Yield 84.0 VAA-05-A 14 14:51 4 13:10 Apha Radiu Result 0 163 %Yield 100 copic Thoriu Result 0.225 0.266 0 00863	Qualifier F-PS-201 Im (GFPC) Qualifier Im (Alpha S	Limits  30 - 110  Count Uncert. (20+l-) 0.487  Limits 40 - 110  Spectrometry) Count Uncert. (20+l-) 0.119 0.0909 0.0490	Total Uncert. (2σ+/-) 0 488  Total Uncert. (2σ+/-) 0 121 0 0938	RL 1.00 1.00	MDC 0.891 MDC 0.163 0.0233	Unit  pCi/Sample  Unit  pCi/Sample pCi/Sample	Prepared 07/22/14 11:27  Lab San  Prepared 07/22/14 15:40  Prepared 07/22/14 15:40  Prepared 07/22/14 11:27 07/22/14 11:27	O7/28/14 15:29  nple ID: 160- Matri  Analyzed  07/23/14 15:46  Analyzed  07/23/14 15:46  Analyzed  07/28/14 15:25  07/28/14 15:25	7447 ix: Fill

Page 12 of 18

8/11/2014

## **Client Sample Results**

Client. Tetra Tech EM Inc.

Project/Site: West Lake Landfill - Filters

TestAmerica Job ID: 160-7447-1

Lab Sample ID: 160-7447-5

Matrix: Filter

Client Sample ID: WAA-05-AF-PS-20140710

Date Collected: 07/10/14 14:51 Date Received: 07/14/14 13:10

			Count Uncert	Total Uncert.						
Analyte	Result	Qualifier	(20+/-)	(20+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Uranium-233/234	0 0580	UV	0.0549	0.0552	1.00	0.0793	pCi/Sample	07/22/14 11:27	07/28/14 15 29	1
Uranium-235/236	0.0206	υĠ	0.0292	0 0292	(1.00)	0.0309	pCi/Sample	07/22/14 11:27	07/28/14 15 29	1
Uranium-238	0.0827	7	0.0523	0 0527	1.00	0 0248	pCi/Sample	07/22/14 11:27	07/28/14 15 29	1
Tracer	%Yield	Qualifier	Limits					Prepared	Analyzed	Dil Fac
Uranium-232	85,3		30 - 110					07/22/14 11.27	07/28/14 15.29	1

Client Sample ID: WAA-00-AF-FB-20140710

Date Collected: 07/10/14 00:00
Date Received: 07/14/14 13:10

Lab Sample ID: 160-7447-6

Matrix: Filter

			Count	Total						
			Uncert.	Uncert.						
Analyte	Result	Qualifier	(20+/-)	(20+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Total Alpha Radium	0.644		0 612	0 615	1.00	0.967	pCi/Sample	07/22/14 15:40	07/23/14 15:47	1
Carrier	%Yield	Qualifier	Limits					Prepared	Analyzed	Dil Fac
Ba Carrier	101		40-110					07/22/14 15:40	07/23/14 15.47	1
Method: A-01-R - Iso	topic Thoriu	m (Alpha S	pectrometry)							
			Count	Total						
			Uncert.	Uncert.						
Analyte	Result	Qualifier	(20+/-)	(20+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Thorium-228	0.213	I	0.111	0.113	1.00	0.151	pCi/Sample	07/22/14 11:27	07/28/14 15:25	1
Thorium-230	0.285	ゴ	0.103	0.106	1.00	0.0989	pCi/Sample	07/22/14 11:27	07/28/14 15:25	1
Thorium-232	0 0367	W	0.0441	0.0442	1.00	0.0704	pCi/Sample	07/22/14 11 27	07/28/14 15:25	1
Tracer	%Yield	Qualifier	Limits					Prepared	Analyzed	DII Fac
Thorium-229	96.4		30 - 110					07/22/14 11.27	07/28/14 15:25	1
Method: A-01-R - Iso	topic Uraniu	ım (Alpha S	Spectrometry)							
			Count	Total						
			Uncert.	Uncert.						
Analyte	Result	Qualifier	(20+/-)	(20+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Uranium-233/234	0.154	Ī	0.0764	0.0775	1.00	0.0654	pCi/Sample	07/22/14 11:27	07/28/14 15.29	1
Uranium-235/236	0.0319	J	0 0368	0.0369	1.00	0.0319	pCi/Sample	07/22/14 11:27	07/28/14 15 29	1
Uranium-238	0.0853	7	0.0539	0.0544	1.00	0.0256	pCi/Sample	07/22/14 11:27	07/28/14 15:29	1
Tracer	%Yield	Qualifier	Limits					Prepared	Analyzed	Dil Fac
Uranium-232	87.0		30.110		1 ) -			07/22/14 11 27	07/28/14 15 29	1

21 Aug 14

Total

Uncert.

 $(2\sigma + / -)$ 

0.606

TestAmerica Job ID: 160-7447-1

Client Sample ID: Method Blank

Analyzed

07/23/14 15:43

Analyzed

07/23/14 15:43

Prep Type: Total/NA

Prep Batch: 133148

Prep Type: Total/NA

Prep Batch: 133148

Dil Fac

Dil Fac

Method: 9315 - Total Apha Radium (GFPC)

0.6548 U

Lab Sample ID: MB 160-133148/1-A **Matrix: Filter** 

Analysis Batch: 133476

Total Alpha Radium

**Matrix: Filter** 

Analyte

Carrier Ba Carrier

**Matrix: Filter** 

Total Alpha Radium

Analysis Batch: 133476

мв мв Result Qualifier Analyte

MB MB Carrier %Yield Ba Carrier 74 6

Lab Sample ID: LCS 160-133148/2-A

LCS LCS %Yield Qualifier

51.6

93.8

Lab Sample ID: LCSD 160-133148/3-A

Qualifier Limits

Spike

Added

Limits

40 - 110

Spike

Added

45.0

45.0

40 - 110

Count

Uncert.

(20+/-)

0.603

LCS LCS

LCSD LCSD

Result Qual

38.92

Result Qual

38.40

RL

1.00

Total Uncert. (2σ+/-)

RL 1.00 4 95

MDC Unit

0.929 pCi/Sample

MDC Unit 1.56 pCi/Samp

%Rec 85

Prepared

07/22/14 15:40

Prepared

07/22/14 15:40

Client Sample ID: Lab Control Sample

Limits 65 - 150

%Rec.

Client Sample ID: Lab Control Sample Dup

Prep Type: Total/NA

Prep Batch: 133148

Analysis Batch: 133476

Analyte Total Alpha

Radium LCSD LCSD %Yield Qualifier Carrier

Limits 40 - 110 Total

Uncert. RI  $(2\sigma + /-)$ 1.00 4.68

RL

1.00

1.00

1.00

MDC Unit

0.176

0.0760

0.0604

pCi/Sample

pCi/Sample

pCi/Sample

MDC Unit 1.09 pCi/Samp

%Rec

Prepared

07/22/14 11:27

%Rec. Limits 65 - 150

RER RER 0.05

Limit

Analyte

Tracer

Thorium-228

Thorium-230

Thorium-232

Thorium-229

Ba Carrier

Method: A-01-R - Isotopic Thorium (Alpha Spectrometry)

MB MB

Lab Sample ID: MB 160-133096/1-A Matrix: Filter

Analysis Batch: 134485

Count Total Uncert. Uncert.

(20+/-)

0.122

0.123

0.0274

Result Qualifier  $(2\sigma + / -)$ 0.121 0.1909 0.4099 0.118 0.007899 U 0.0274

MR MR Qualifier Limits %Yield 93.9 30 - 110 Client Sample ID: Method Blank

Analyzed

07/28/14 15:25

Prep Type: Total/NA Prep Batch: 133096

07/28/14 15:25 07/22/14 11:27 07/28/14 15:25 07/22/14 11:27

Prepared Analyzed 07/22/14 11:27 07/28/14 15:25

**Dil Fac** 

Dil Fac

1

1

TestAmerica St. Louis

TestAmerica Job ID: 160-7447-1

Prep Type: Total/NA

Prep Batch: 133096

Prep Batch: 133096

RER

0.62

Method: A-01-R - Isotopic Thorium (Alpha Spectrometry) (Continued)

LCS LCS %Yield Qualifier

Lab Sample ID: LCS 160-133096/2-A

Analysis Batch: 134486

Analyte

Tracer Thorium-229

Analyte

Tracer

Thorium-230

Thorium-229

Thorium-230

**Matrix: Filter** 

Matrix: Filter

Total Uncert.

LCS LCS Result Qual 19.37

LCSD LCSD

Result Qual

17.25

(2<del>0+/-</del>) 1.80

Total

Uncert.

(2g+/-)

1.62

RL 1.00

RI

1.00

MDC Unit 0.0590 pCi/Samp

MDC Unit

0.0226 pCi/Samp

%Rec 112

%Rec

100

%Rec. Limits 81\_118

%Rec.

Limits

81 - 118

Client Sample ID: Lab Control Sample

Client Sample ID: Lab Control Sample Dup Prep Type: Total/NA

RER Limit

Analysis Batch: 134487

89 7

Lab Sample ID: LCSD 160-133096/3-A

LCSD LCSD

**%Yield Qualifier** 

94.5

Limits 30 - 110

Spike

Added

25.5

26.0

I imits

30 \_ 110

26.24

Spike

Added

17.3

Spike

Added

Limits

30 - 110

17.3

Method: A-01-R - Isotopic Uranium (Alpha Spectrometry)

MB MB

Lab Sample ID: MB 160-133097/1-A

Lab Sample ID: LCS 160-133097/2-A

Matrix: Filter

Matrix: Filter

Uranium-233/23 Uranium-238

Analyte

Tracer

Uranium-232

Analysis Batch: 134503

Analysis Batch: 134502

Client Sample ID: Method Blank Prep Type: Total/NA

Prep Batch: 133097

Count Total Uncert. Uncert. (2g+/-)

Dil Fac RL MDC Unit Prepared Analyzed Analyte Result Qualifier (2g+/-) 0.127 pCi/Sample 07/28/14 15:29 1.00 07/22/14 11:27 Uranium-233/234 -0.01758 U 0.0556 0.0556 0.0379 0.0379 1.00 0.0837 pCi/Sample 07/22/14 11:27 07/28/14 15:29 1 Uranium-235/236 0.01094 U 07/28/14 15:29 0.0466 0.0671 pCi/Sample 07/22/14 11:27 Uranium-238 0.04387 U 0.0464 1.00

MB MB Qualifier Limits Tracer %Yield 30 - 110 Uranium-232 83.3

LCS LCS

79.3

**%Yield Qualifier** 

Prepared Analyzed Dil Fac 07/22/14 11:27 07/28/14 15:29

Client Sample ID: Lab Control Sample

Prep Type: Total/NA Prep Batch: 133097

Total

2.41

1.00

LCS LCS Uncert. Result Qual (20+/-) 25.20 2.32

RL MDC Unit 1.00 0.0270 pCi/Samp

0.0687 pCi/Samp

%Rec.

%Rec 84 - 120

Limits

101 82 - 122

8/11/2014

TestAmerica St. Louis

## **QC Sample Results**

Client: Tetra Tech EM Inc.

Project/Site: West Lake Landfill - Filters

TestAmerica Job ID: 160-7447-1

#### Method: A-01-R - Isotopic Uranium (Alpha Spectrometry) (Continued)

Lab Sample ID: LCSD 160-133097/3-A

**Matrix: Filter** 

Analysis Batch: 134504

Client Sample ID: Lab Control Sample Dup Prep Type: Total/NA

Prep Batch: 133097

Total RER %Rec. LCSD LCSD Uncert. Limit RER Result Qual  $(2\sigma + /-)$ RL MDC Unit %Rec Limits

Spike Added Analyte 25.27 2.34 1.00 0.0910 pCi/Samp 84 - 120 0.01 25.5 Uranium-233/23 0.01 82 - 122 Uranium-238 26.0 26.16 2.41 1.00 0.0726 pCi/Samp 100

Page 16 of 18

LCSD LCSD

Limits Tracer %Yield Qualifier Uranium-232 78.0 30 - 110

## **QC Association Summary**

Client: Tetra Tech EM Inc.

Project/Site: West Lake Landfill - Filters

TestAmerica Job ID: 160-7447-1

Rad

Prep Batch: 133096

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-7447-1	WAA-01-AF-PS-20140710	Total/NA	Filter	ExtChrom	
160-7447-2	WAA-02-AF-PS-20140710	Total/NA	Filter	ExtChrom	
160-7447-3	WAA-03-AF-PS-20140710	Total/NA.	Filter	ExtChrom	
160-7447-4	WAA-04-AF-PS-20140710	Total/NA	Filter	ExtChrom	
160-7447-5	WAA-05-AF-PS-20140710	Total/NA	Filter	ExtChrom	
160-7447-6	WAA-00-AF-FB-20140710	Total/NA	Filter	ExtChrom	
LCS 160-133096/2-A	Lab Control Sample	Total/NA	Filter	ExtChrom	
LCSD 160-133096/3-A	Lab Control Sample Dup	Total/NA	Filter	ExtChrom	
MB 160-133096/1-A	Method Blank	Total/NA	Filter	ExtChrom	

Prep Batch: 133097

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-7447-1	WAA-01-AF-PS-20140710	Total/NA	Filter	ExtChrom	
160-7447-2	WAA-02-AF-PS-20140710	Total/NA	Filter	ExtChrom	
160-7447-3	WAA-03-AF-PS-20140710	Total/NA	Filter	ExtChrom	
160-7447-4	WAA-04-AF-PS-20140710	Total/NA	Filter	ExtChrom	
160-7447-5	WAA-05-AF-PS-20140710	Total/NA	Filter	ExtChrom	
160-7447-6	WAA-00-AF-FB-20140710	Total/NA	Filter	ExtChrom	
LCS 160-133097/2-A	Lab Control Sample	Total/NA	Filter	ExtChrom	
LCSD 160-133097/3-A	Lab Control Sample Dup	Total/NA	Filter	ExtChrom	
MB 160-133097/1-A	Method Blank	Total/NA	Filter	ExtChrom	

Prep Batch: 133148

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-7447-1	WAA-01-AF-PS-20140710	Total/NA	Filter	DPS-0	
160-7447-2	WAA-02-AF-PS-20140710	Total/NA	Filter	DPS-0	
160-7447-3	WAA-03-AF-PS-20140710	Total/NA	Filter	DPS-0	
160-7447-4	WAA-04-AF-PS-20140710	Total/NA	Filter	DPS-0	
160-7447-5	WAA-05-AF-PS-20140710	Total/NA	Filter	DPS-0	
160-7447-6	WAA-00-AF-FB-20140710	Total/NA	Filter	DPS-0	
LCS 160-133148/2-A	Lab Control Sample	Total/NA	Filter	DPS-0	
LCSD 160-133148/3-A	Lab Control Sample Dup	Total/NA	Filter	DPS-0	
MB 160-133148/1-A	Method Blank	Total/NA	Filter	DPS-0	

Client: Tetra Tech EM Inc.

Project/Site: West Lake Landfill - Filters

Method: 9315 - Total Apha Radium (GFPC)

Matrix: Filter Prep Type: Total/NA

			Percent Yield (Acceptance Limits)
		Ва	
_ab Sample ID	Client Sample ID	(40-110)	
160-7447-1	WAA-01-AF-PS-20140710	101	
160-7447-2	WAA-02-AF-PS-20140710	100	
160-7447-3	WAA-03-AF-PS-20140710	99.7	
160-7447-4	WAA-04-AF-PS-20140710	102	
160-7447-5	WAA-05-AF-PS-20140710	100	
160-7447-6	WAA-00-AF-FB-20140710	101	
CS 160-133148/2-A	Lab Control Sample	51.6	
CSD 160-133148/3-A	Lab Control Sample Dup	93.8	
MB 160-133148/1-A	Method Blank	74.6	
Tracer/Carrier Legend			
Ba = Ba Carrier			

Method: A-01-R - Isotopic Thorium (Alpha Spectrometry)

Matrix: Filter Prep Type: Total/NA

			Percent Yield (Acceptance Limits)
		Th-229	
Lab Sample ID	Client Sample ID	(30-110)	
160-7447-1	WAA-01-AF-PS-20140710	95.1	
160-7447-2	WAA-02-AF-PS-20140710	95.4	
160-7447-3	WAA-03-AF-PS-20140710	100	
160-7447-4	WAA-04-AF-PS-20140710	90.7	
160-7447-5	WAA-05-AF-PS-20140710	96.8	
160-7447-6	WAA-00-AF-FB-20140710	96.4	
LCS 160-133096/2-A	Lab Control Sample	89.7	
CSD 160-133096/3-A	Lab Control Sample Dup	94.5	
MB 160-133096/1-A	Method Blank	93.9	
Tracer/Carrier Legend			
Th-229 = Thorium-229			

Method: A-01-R - Isotopic Uranium (Alpha Spectrometry)

Matrix: Filter Prep Type: Total/NA

		Percent Yield (Acceptance Limits)				
		U-232				
Lab Sample ID	Client Sample ID	(30-110)				
160-7447-1	WAA-01-AF-PS-20140710	86.3				
160-7447-2	WAA-02-AF-PS-20140710	83.6				
160-7447-3	WAA-03-AF-PS-20140710	88.6				
160-7447-4	WAA-04-AF-PS-20140710	84.0				
160-7447-5	WAA-05-AF-PS-20140710	85.3				
160-7447-6	WAA-00-AF-FB-20140710	87.0				
CS 160-133097/2-A	Lab Control Sample	79.3				
CSD 160-133097/3-A	Lab Control Sample Dup	78.0				
MB 160-133097/1-A	Method Blank	83.3				

Page 18 of 18

TestAmerica St. Louis